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MINISTRY OF POWER

# **EXPLOSION AT BLAENHIRWAUN COLLIERY, CARMARTHENSHIRE**

## **REPORT**

On the causes of, and circumstances  
attending, the explosion which occurred at  
Blaenhirwaun Colliery, Carmarthenshire,  
on 6th September, 1955

*BY*

**T. A. JONES, O.B.E.,**  
*H.M. Divisional Inspector of Mines*

*Presented to Parliament by the Minister of Power  
by Command of Her Majesty  
November 1957*

**LONDON**

**HER MAJESTY'S STATIONERY OFFICE**

**TWO SHILLINGS NET**

**Cmnd. 287**





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# **Report on the causes of, and circumstances attending, the explosion which occurred at Blaenhirwaun Colliery, Carmarthenshire, on 6th September, 1955.**

*The Right Honourable Lord Mills, K.B.E.,  
Minister of Power.*

*October, 1957*

MY LORD,

## **INTRODUCTORY**

In accordance with the instructions given by your predecessor under the terms of Section 82 of the Coal Mines Act, 1911, I beg to submit my report on the causes of, and circumstances attending, the explosion which occurred on the "Q" face in the Lower Pumpquart seam at Blaenhirwaun colliery, Carmarthenshire, on 6th September, 1955, when four persons were killed and 13 others injured. One of the injured died in hospital on the 18th and another on the 30th September, 1955, bringing the death roll to six.

On 23rd November, 1955, Mr. W. Lock Smith, H.M. Coroner for the Three Commotys District of the County of Carmarthen, sitting with a jury, concluded the holding of an Inquest on the bodies of the six deceased persons and recorded a verdict to the effect that all six had died from injuries accidentally received in a coal gas explosion, the cause of which had yet to be ascertained.

## **I.—DESCRIPTION OF THE COLLIERY**

### **General**

Blaenhirwaun colliery is situated near the village of Cross Hands some 16 miles to the northwest of Swansea, near the northern extremity of the coalfield. It has been a working mine producing first grade anthracite coal since 1913. The output is about 350 tons per day and the numbers of persons employed are 360 below ground and 80 on the surface.

It is served by two vertical shafts, both sunk to the Green Vein. The No. 1 shaft, 10 feet in diameter and 155 yards deep, is the upcast equipped with a Walker Paddle fan producing about 55,000 cubic feet of air per minute at a water gauge of 3.125 inches. The No. 2 shaft, 13 feet in diameter and 212 yards deep, is the downcast and main winding shaft for men and mineral.

### **Management**

The mine is in the No. 1 Area of the South Western Division of the National Coal Board, and the principal officials are as follows:—

Mr. J. G. Tait, B.Sc.	...	Area General Manager.
Mr. J. D. H. Davies	...	Area Production Manager.
Mr. D. J. King	...	Deputy Area Production Manager (Operations).
Mr. I. R. Jeffreys	...	Manager.
Mr. J. H. Morgan	...	Under-manager.

### **Seams worked and Lamps used**

The names of the seams now worked, given in descending order, are the Big Vein, Stanllyd and Lower Pumpquart.

The use of safety lamps has always been required throughout the mine, and automatic firedamp detectors are required by the Coal Mines (Ventilation) General Regulations, 1947, to be provided on longwall faces where electric power is used. The lamps in general use throughout the mine are Nife N.C. 113C electric cap lamps, with E. Thomas and Williams Cambrian No. 1 flame safety lamps and Naylor Spiralarms Type M for use by workmen as firedamp detectors. Prestwich Patent Protector Type 6 flame safety lamps are used as officials' inspection lamps.

### **The Lower Pumpquart Seam**

The seam has an average thickness of about 3 feet with a roof of clift and a floor of fireclay. The volatile content of the coal on an ash-free dry basis is 5.5 per cent. It was reached by driving cross measure drifts from the Green Vein some 26 years ago and has since been extensively worked by the longwall method. The whole of the area worked is geologically disturbed with numerous faults, patches of barren ground and steep and variable gradients.

At the time of the explosion the workings in the seam consisted of two longwall, single-unit, conveyor faces, known as the " P " and " Q " faces respectively. These faces were ventilated in series, the air current first entering the " P " face as shown on Plan No. 1.

## **II.—THE " Q " FACE**

### **General Description**

This face was advancing to the north in a virgin area. It was about 80 yards long with the intake loading gate at the right and the return supply gate at the left. The gates were advancing to the rise at gradients of 1 in 2.5 in the loading gate and 1 in 2.1 in the supply gate; on the face there was a rise from right to left at a gradient of 1 in 3.5. The ventilation was ascensional.

The face started as a production unit in January, 1955, and had advanced about 90 yards. It was the intention to advance it a further 20 yards and then replace it by a face, formed by the ribside of the loading gate, to advance to the east.

### **Method of Work and Organisation**

The coal was hand-got with the aid of pneumatic picks and of shots fired in flanking holes drilled in the solid coal. It was filled on to a retarder conveyor on the face and conveyed to a tub-loading point by means of two belt conveyors in tandem in the loading gate. The face conveyor was compressed-air-driven and the belt conveyors were electrically driven.

Top rippings were taken in both gates with an additional floor ripping in the supply gate. Shots were fired in all the rippings. Both gates were supported with steel arch girders.

For the purpose of dust suppression, the pneumatic picks were fitted with water feed, hand sprays were used on the face, and fixed sprays at the transfer and loading points. Water infusion of the face had been tried but had proved abortive due to the fact that the face was advancing on the ends of well defined cleats in the coal.

The face was worked on a 48-hours cycle, and the operations usually performed on each of the three shifts were as follows:—

Morning Shift	...	Coal getting and filling. Ripping and packing
7.0 a.m. to 2.30 p.m.		in the supply gate.

Afternoon Shift ...	...	Ripping and packing in both gates. Withdrawal of supports and advancing of strip packs on the face. Moving forward the conveyor on alternate days.
3.0 p.m. to 10.30 p.m.		
Night Shift ...	...	Drilling shot holes and firing shots in coal.
11.0 p.m. to 6.30 a.m.		

The face formed a deputy's district on each shift. Except at week-ends, each deputy made the pre-shift inspection for the succeeding shift. The " P " and " Q " faces together formed an overman's district on each of the three shifts.

### **Roof Support and Control**

The roof on the face was supported by means of wood bars set at right angles to the face on wood props. Each of the gates had solid coal on one side, and on the other side a pack, about 10 yards wide, built with stone from the rippings. Along the face, strip packs about 6 yards wide were built with stone from the intervening wastes which were about 9 yards wide. Two hardwood chocks were maintained at the edge of each waste. Roof control had always been satisfactory on this face and there was no history of roof weighting or falls of ground.

### **Ventilation and the Occurrence of Firedamp**

The " Q " face was ventilated by an air current of about 8,000 cubic feet per minute which had already ventilated the " P " face. According to all the evidence the ventilation has always been adequate, and on only two occasions, 5th May and 27th June, 1955, had inflammable gas been detected and reported by the deputies. On each occasion a trace of inflammable gas was reported at the ripping face in the supply gate.

After the first report of inflammable gas on 5th May, the manager gave instructions for a hurdle sheet to be erected and maintained across the roadhead of the supply gate so as to divert a flow of air into the ripping face. The deputies foresaw difficulties in maintaining a hurdle sheet on this steep gradient and suggested that a small fan installed so as to blow air on to the ripping face would be preferable. The manager acquiesced and, on his instructions, a 12-inch diameter, Meco, compressed-air turbine fan was installed. This fan, with a 6-foot length of sheet steel ducting attached on each side, was suspended by means of wire from the steel arch supports so that the ducting was approximately at the same gradient as the roadway and with the outlet ducting pointing to the ripping face. The fan with the ducting was moved forward as the ripping face advanced, and this method of ventilating the ripping lip was still in operation when the explosion occurred.

Samples of air taken in accordance with the requirements of Regulation 3 (a) (i) of the Coal Mines (Ventilation) General Regulations, 1947, since the face started in January, 1955, showed a percentage of methane in excess of 0.4 on only three occasions; these were 0.55 on 28th May, 1.10 on 27th June and 0.70 on 19th August.

### **The Morning Shift on 6th September**

The morning shift on 6th September commenced at the usual time. The pre-shift inspection had been made by the night shift deputy who had reported everything in order. The face conveyor had been moved forward on the afternoon shift of the previous day, and the strip packs and waste-edge chocks had been advanced. The roadside pack of the loading gate had also been advanced, but the roadside pack of the supply gate was about 8 yards back from the coal face. Over a length of a few yards at the return end of the face, the seam had thickened from its normal 3 feet to about 7 feet and the slip of what appeared to be a downthrow fault had been exposed, running roughly in line with the ribside of the supply gate.



There were 13 colliers engaged in coal getting and two advancing the top rippings in the supply gate. Also employed on the face were two conveyor attendants, one at the drive of the retarder conveyor at the return end of the face and the other at the transfer point at the intake end. There were two men getting supplies of timber to the face in the supply gate, and seven men outbye of the face on the loading gate and haulage road. These men with the deputy and shot firer brought the total in the district to 28.

The deputy commenced his first inspection of the face at about 8.0 a.m. and was accompanied by the overman. Between 9.0 a.m. and 11.30 a.m. the deputy made another inspection of the face during which he fired four shots in the coal. He was making a third inspection when the explosion occurred at about 1.0 p.m. He maintains that during these inspections and during his shot firing operations he made careful tests for inflammable gas and found no trace. This is confirmed in respect of his first inspection by the overman who accompanied him.

The shot firer employed on this face fired an aggregate of 22 shots between 7.45 a.m. and 12.20 p.m. He fired 20 of these shots in the coal on the face and two in the supply gate top rippings shortly before noon. The last coal shots to be fired were at the intake end of the face at about 12.20 p.m. All the shots were fired singly. The shot firer maintains that he made careful tests for inflammable gas during his operations and found no trace.

According to the evidence of officials and workmen, there was no sign of any roof weighting and conditions appeared normal in every way up to the time the explosion occurred.

### III.—NARRATIVE OF THE EXPLOSION

At about 1.0 p.m. the deputy, making his third inspection and travelling with the air current, had reached the return end of the face and had found work proceeding normally and everything apparently in good order. He was one of a group of nine persons in and about the supply gate roadhead who were suddenly enveloped in flame and blown off their feet by the explosion. They all sustained severe burn injuries, from which two of them subsequently died, but they were not injured by blast. Two colliers working together about 25 yards down the face from the supply gate were buried beneath a large fall of roof which occurred as a result of the roof supports being displaced and blown downhill by the blast. When they were recovered from beneath the fall both bodies showed evidence of severe burn injuries caused by the passage of the explosion flame before the fall occurred. Another collier working some 20 yards farther down the face was badly burned and must have died instantly from multiple injuries caused by blast. The men working further down the face and at the roadhead of the loading gate were blown downhill and three of them sustained burning injuries, but in no case were the injuries of a serious nature. The only person in the supply gate outbye of the roadhead was one of the two men engaged in getting timber to the face; his dead body, badly burned and severely injured by blast, was found some 90 yards outbye from the face.

The positions of the persons in the affected area at the time of the explosion are shown on Plan No. 2.

The alarm was immediately raised by those uninjured in the loading gate; help with additional first-aid equipment and stretchers quickly arrived on the scene, and the emergency organisation of rescue and ambulance services was put into operation without delay. Despite the difficulties created by the fall of roof which blocked the face, all the injured were soon brought out, given efficient first-aid treatment at an emergency dressing station established in the



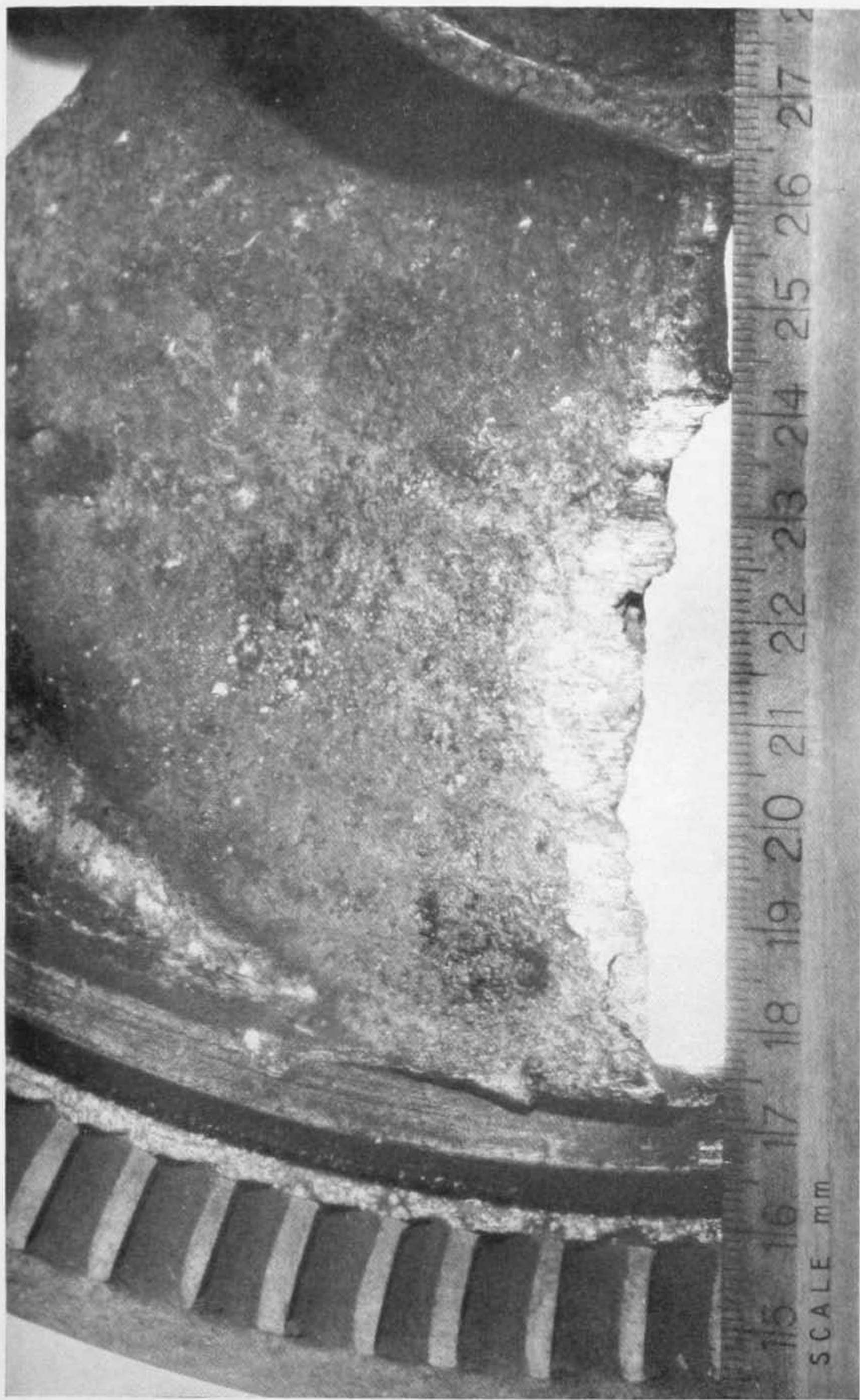


PLATE I.—Fan blade showing results of the abrasion and the embedded fragments of stone (see page 8).



district, and conveyed to the surface and thence to hospital. The first aid and subsequent treatment of the injured will be dealt with more fully later in this report.

It took until the following day to clear sufficient of the fall of roof on the face for the recovery of the bodies of the two men buried beneath it. Both men had obviously been instantly killed.

#### IV.—THE CAUSE OF THE EXPLOSION

##### **The Nature of the Explosion**

All the evidence pointed conclusively to an explosion of firedamp having occurred at the top corner of the face in the vicinity of the supply gate roadhead, causing flame and blast to be projected down the face against the air current and outbye along the supply gate. There was evidence of the passage of flame over a length of about 60 yards of the supply gate measured from the coal face and over a length of about 75 yards along the face measured from the ribside at the return end. There was not the slightest indication that coal dust had played any part, and the explosion had obviously been one of methane.

##### **The Source of the Methane**

The only firedamp detected after the explosion was that issuing in the form of a “blower” from the roof some 20 yards down the face from the supply gate ribside and near the return-side edge of the roof cavity formed by the fall. This issue of firedamp was of such magnitude—probably about 400 cubic feet per minute—that it had to be piped into the return airway before satisfactory ventilation standards could be restored on the return side of the point of issue. The deputy is positive that this gas was not issuing when he passed the spot a few minutes before the explosion occurred. Furthermore, had this gas been issuing for any appreciable length of time prior to the explosion, the men working near the top corner of the face would undoubtedly have been affected by the high concentration of methane which would quickly accumulate there.

It must be concluded that it was methane from this “blower” which provided all the fuel for the explosion, and that the “blower” commenced to issue only a minute or so before the explosion occurred. It is very unlikely that the “blower” would have caused pollution of the atmosphere downhill, but it would almost immediately have raised into the explosive range the methane content of the air current passing.

##### **The Igniting Medium**

All possible igniting mediums were considered and carefully investigated, as follows:

###### *Safety lamps*

All the electric and flame safety lamps which were in use in the district at the time of the explosion were sent, in the condition in which they were brought out of the mine, for examination and testing at the Safety in Mines Research Establishment. Many of the lamps had sustained damage, but in all cases the damage was found to be consistent with that which might easily be sustained as a consequence of an explosion, and no evidence was found to suggest that any of the lamps were likely to be the source of an ignition of firedamp.

###### *Electricity*

All electrical apparatus and mains lighting equipment in the district was subjected to a thorough examination and found to be in good order. Moreover, there was no electrical apparatus or mains lighting equipment in the part of the district affected



### *Naked lights and smoking*

During the recovery operations cigarettes wrapped in pieces of newspaper were found in the pockets of two articles of clothing on the face. This focussed attention on smoking as an igniting medium, but after careful consideration this was ruled out. No evidence was found to suggest that smoking had actually taken place in the district, and the possibility that anyone in the affected part at the critical time could have been smoking or attempting to smoke without being detected was very remote. The finding of contraband in this safety lamp mine is, nevertheless, very disturbing.

### *Frictional sparks from stones*

Frictional sparking caused by falling stones was considered and ruled out. The only fall of ground found after the explosion was the one on the face, and this must have occurred after the explosion, otherwise the bodies beneath it would not have been exposed to the flame.

### *Shot firing*

It is certain that no shot firing was in progress at the time the explosion occurred. Shots had been fired in the top rippings in the supply gate about an hour earlier, and consideration was given to the possibility that methane ignited by these shots had continued to burn in roof breaks or bed separation planes. Nothing was found to support this theory and it was eventually ruled out.

### *Compressed-air hose*

Two lengths of compressed-air hose having patched leaks were considered and ruled out after expert examination of the patches at the Safety in Mines Research Establishment.

### *The compressed-air turbine fan at the supply gate rippings*

This was a Mecro, Type CF3, compressed-air driven, four-bladed fan, 12 inches in diameter, in which both rotor and casing were made from an aluminium alloy. It was sent exactly as it was found after the explosion to the Safety in Mines Research Establishment where tests showed it to be in good running order. There were no signs of the rotor having fouled the stator, but each of the four blades showed considerable damage by abrasion of its trailing edge, and microscopic examination revealed small fragments of rock embedded in the aluminium of the blades where recent abrasion had occurred. In one case a fragment of stone was found embedded in caked dust near the tip of the blade.

A photograph taken at the Safety in Mines Research Establishment and included with this report shows the results of the abrasion and the embedded stone (see Plate I).

The only feasible explanation of this damage seemed to be that, when the fan was running in the supply gate, the rotating blades had rubbed against pieces of stone which had entered via the outlet ducting and come to rest against the spiders of the fan casing so as to foul the trailing edges of the rotating blades. With the ducting lying at the steep gradient of the gate and with the outlet pointing to the ripping lip while the ripping shots were fired, the presence of pieces of stone in a position to foul the trailing edges of the blades is easily explained. Furthermore, one of the men working at the supply gate rippings stated in evidence that, a few minutes before the explosion occurred, he noticed that the fan appeared to be running sluggishly, so he struck the fan casing with an iron bar whereupon the fan picked up speed. He had done this on previous occasions under similar circumstances and always with the same result. The obvious explanation is that stones from the ripping shots had been projected into the outlet ducting and were fouling the fan blades, thus causing the sluggish running; a blow on the casing moved the stones and allowed the fan to pick up speed. The stones would, of course, still be in position to foul the blades.

At the Safety in Mines Research Establishment to carry out frictional sparking tests with the fan itself, but experiments were carried out in which discs of an alloy similar to that used for the fan blades were made to rotate under very light pressure in contact with pieces of stone obtained from the supply gate rippings. These experiments proved that at rubbing speeds less than those which would occur in the normal running of the fan, sparks were produced which readily ignited a methane air mixture.

### **Conclusions**

On this evidence, coupled with the lack of supporting evidence for any of the other possible igniting mediums, it was concluded that the explosion had been initiated by this fan and that the sequence of events culminating in the explosion was as follows:

At a time when work was proceeding normally with the ventilation taking its normal course, a blower of firedamp of considerable magnitude suddenly issued from the roof some 20 yards down the face from the supply gate. The rate of emission was such that within a minute or so the methane content of the air current on the return side of the point of issue was raised above the lower explosive limit. Simultaneously, migration of the firedamp caused a richer and more highly explosive mixture to accumulate in the top corner of the face. As soon as the atmosphere being drawn through the fan became inflammable, it was ignited by sparks produced by friction between the trailing edges of the fan blades and pieces of stone which had been projected by the ripping shots into the outlet ducting and were now fouling the path of the blades. Flame instantly spread throughout the inflammable atmosphere and reached the highly explosive accumulation at the top corner of the face, whereupon flame and blast were projected down the face and outbye along the supply gate. The men at the top end of the face were enveloped in flame but were too near the seat of the explosion to be affected.

It may be asked why, with the fan continuing to run after the explosion, this sequence of events was not repeated. The answer seems to be that before the ventilating current could resume its normal course after being interrupted by the blast down the face, the fall of roof occurred. The obstruction caused by this fall so reduced the quantity of air flowing that, with the issue of firedamp continuing undiminished, the methane content of the atmosphere throughout the area on the return side of the point of issue was above the upper explosive limit. This state of affairs continued until the fan was stopped before steps had been taken to restore the ventilation.

## **V.—MATTERS ARISING FROM THE EXPLOSION**

### **The Compressed-air Turbine Fan**

It is a tragic feature of this occurrence that there was never any necessity for the installation in the supply gate of the fan which initiated the explosion. Indeed, had there been strict compliance with the requirements of the Coal Mines (Ventilation) General Regulations, 1947, it is very unlikely that the fan would ever have been installed.

A fan installed in a gateway of a longwall face could not be termed an auxiliary fan as defined in Regulation 18 (1). The installation of this fan was therefore governed by Regulation 15 (1) which requires that "No fan (other than an auxiliary fan) may be installed below ground unless result of a survey of the ventilation of every part of the mine liable to be affected made at the time by a qualified person and of a report as to the appropriate



type, size and location of the proposed fan prepared by a qualified engineer, the manager is satisfied that it is necessary or expedient for the proper ventilation of that part of the mine that it should be installed". In the case of this fan, which could have no appreciable effect on the ventilation of the district and which merely caused turbulence at the ripping face, it might be open to question as to whether or not such a survey was imperative, but had such a report been made it is most unlikely that a fan would have been installed for a purpose which could have been served equally well, if not better, by the erection of a brattice. Certainly, no fan, auxiliary or other, should be installed below ground without a good deal more thought than was shown in this case.

Another important feature of the occurrence is that it directs attention to the hazard of frictional sparking caused by foreign bodies coming into contact with the rotating blades of a fan. In this case the blades were made of aluminium alloy, but it would appear that the hazard would be much the same if the blades were made of iron or steel. If the ducting leading from such a fan is inclined upwards there must always be a possibility that any foreign body entering the open end of the ducting will gravitate to the fan blades. Most, if not all, of these fans are fitted by the manufacturers with a wire mesh guard on the inlet side; it would be a wise precaution if all these fans were fitted with a guard on both inlet and outlet sides. If the apertures in the mesh were as small as practicable, this particular hazard would be reduced to a minimum.

### **Ventilation of the " Q " Face**

The amount of ventilation produced on the face was adequate under normal circumstances but could not be expected to cope with a sudden and unforeseeable issue of firedamp of such magnitude as occurred a minute or so before the explosion. The failure to provide means for ensuring the adequate ventilation of the return end of the face is, however, a matter for serious criticism.

Due to the geological disturbance and the thickening of the seam from the usual 3 feet to about 7 feet at the roadhead of the supply gate, the thickness of the rippings in this gate had been reduced. This resulted in a shortage of packing material for the gateside pack which, on the morning of the explosion, was about 8 yards back from the coal face. No steps had been taken to counteract the natural tendency for the air current to take the shortest route into the supply gate and thus by-pass the top end of the face.

It is only fair to state that, despite this deficiency in the ventilating arrangements, there is reason to believe that the standard of ventilation at the top end of the face was adequate up to the time the abnormal issue of methane occurred.

This deficiency did, however, have an important bearing on the nature of the explosion. Had the air current been properly directed into the top corner of the face, there would have been no area outside the sweep of the ventilating current in which firedamp from the blower could accumulate by migration to form a highly explosive mixture of methane and air, and the severity of the explosion would undoubtedly have been reduced.

Either additional packing material should have been imported or, if this were impracticable, a brattice should have been erected and maintained so as to direct the ventilating current to the top corner of the face.

### **Contraband and Searching**

The fact that there were cigarettes in the pockets of clothing on this face is a matter for serious concern even though it had no bearing on the occurrence.



Searching was carried out by the deputies on each shift in accordance with an approved system, and the deputy in charge of " Q " face had, in fact, searched 15 of the men employed in his district on the morning shift of 6th September.

The finding of contraband reflects badly on the effectiveness of the searching, but even more so on the mentality of men who would risk taking contraband into a mine where firedamp was, and always had been, a hazard. It is to be hoped that this occurrence will draw attention to the tragic consequences that can result from an open spark or flame produced when methane is present in the atmosphere, and will lead to a stricter observance of the law prohibiting the taking of contraband articles into a safety lamp mine or part of a mine.

## **VI.—FIRST AID AND SUBSEQUENT TREATMENT OF THE INJURED PERSONS**

As soon as news of the occurrence reached the surface of the mine, the emergency organisation was put into operation and functioned smoothly.

Arrangements were made for additional first-aid men and equipment to be sent forthwith to the " Q " district where an emergency dressing station was quickly set up in the " Q " passbye. Within about half an hour, Dr. Ivor Evans, in practice at Penygroes, and Dr. Sheehan, in practice at Cross Hands, arrived at the colliery. They immediately went below ground and proceeded to the " Q " district where they rendered most valuable assistance at the emergency dressing station.

As the injured were brought to the surface they were seen to by Dr. R. Thomas, of Penygroes, assisted by Mr. Schofield, who was in charge of the surface first-aid room, and nursing sisters from neighbouring collieries before being conveyed by motor ambulance to Morriston General Hospital. The last of the ambulances left the colliery at about 5.0 p.m. During the night the nine most serious cases were transferred to the Plastic Surgery Unit at St. Lawrence Hospital, Chepstow.

A tribute was paid by the Superintendent of the Morriston General Hospital to the excellence of the first-aid treatment which the injured had received before admittance.

## **VII.—ACKNOWLEDGMENTS**

I wish to record my grateful appreciation of the helpful co-operation of all who took part in the investigation on behalf of the National Coal Board, the National Union of Mineworkers, the British Association of Colliery Management, and the National Association of Colliery Overmen, Deputies and Shot Firers. Finally, I wish to express my thanks to the officers of the Safety in Mines Research Establishment who carried out the tests and provided the photograph of the fan blades, and to Mr. E. S. Rees, Area Chief Surveyor, National Coal Board, who prepared the plans which accompany this report.

I have the honour to be, My Lord,

Your Lordship's obedient Servant,

T. A. JONES

## APPENDIX

### LIST OF CASUALTIES

#### Killed

J. Davis  
N. Howells  
R. Morris  
W. H. Richards

#### Fatally Injured

D. Pennington  
A. C. Phillips

#### Injured

B. R. Burton  
W. Cooper  
C. Davies  
H. Davies  
S. Davies  
S. Evans  
V. James  
M. Jones  
D. Phillips  
D. H. Rees  
W. J. Wilson





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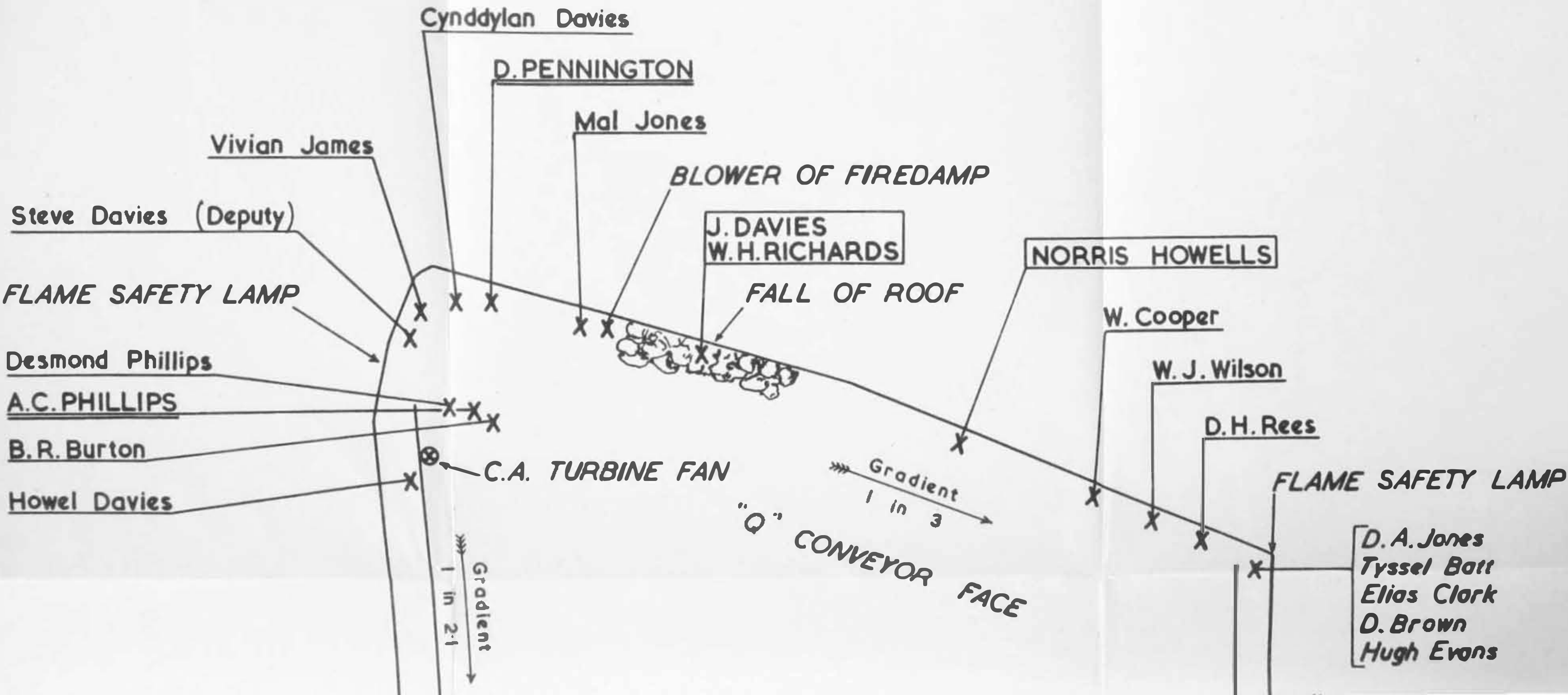
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BLAENHIRWAUN COLLIERY

LOWER PUMPQUART SEAM

PLAN SHOWING POSITIONS OF MEN AT TIME OF THE EXPLOSION

SCALE OF FEET



Gradient  
1 in 2.5

LOADING GATE

SUPPLY GATE

R. MORRIS

### REFERENCE

NAMES OF MEN KILLED INSTANTLY SHOWN THUS.....J. DAVIES

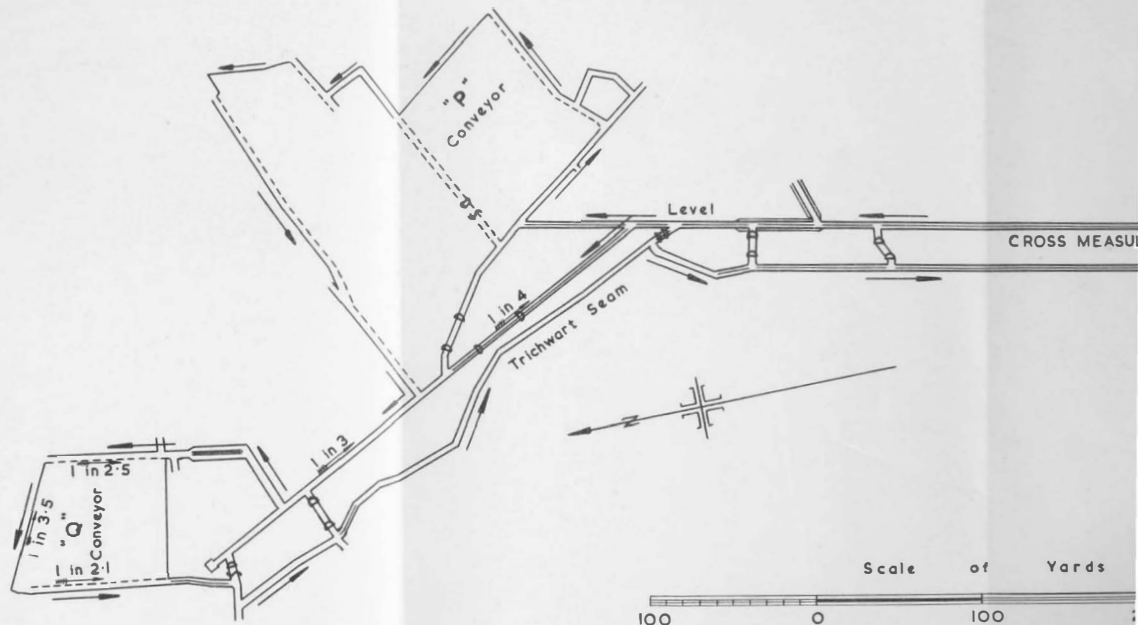
NAMES OF MEN FATALLY INJURED SHOWN THUS.....D. PENNINGTON

NAMES OF OTHER INJURED MEN SHOWN THUS.....B. R. Burton



## PLAN OF WORKINGS IN LOWER PUMPQUART SEAM

DIRECTION OF AIR CURRENT SHOWN BY ARROWS



LOWER PUMPQUART SEAM ON 6<sup>TH</sup> SEPTEMBER 1955

AIR CURRENT SHOWN BY ARROWS THUS →

